American River Basin: Antelope Creek Improvement Project

Attachment 8: Economic Analysis – Water Supply Costs and Benefits

The Antelope Creek Improvement Project provides a broad array of benefits within the American River Basin (ARB) Region and externally to the Sacramento-San Joaquin Delta (Delta). While some of these benefits may be quantifiable via economic analyses, many benefits provided by the project cannot be quantified due to their complex nature. This attachment provides economic analyses of water supply benefits expected as a result of implementation of the Antelope Creek Improvement Project.

Summary

The Antelope Creek Improvement Project is a collaboration between Placer County Water Agency (PCWA) and Placer County Flood Control and Water Conservation District (District). This multi-objective regional flood control, water supply and water quality improvement project is located within the Dry Creek Watershed area of the American River Basin and will be completed in three phases. The project will meet multiple planning objectives by improving water supply and water quality, increasing flood protection, restoring local ecosystems and expanding an existing public recreation corridor.

Phases 1 and 2 of this multi-purpose effort include a regional flood control project on Antelope Creek, a major tributary of the larger Dry Creek. Through the design and construction of two on-channel weirs along an existing open space-protected reach of the creek, the project will provide flood control and flood damage reduction benefits to repeatedly damaged areas of downtown Roseville. The project will reduce peak flood flows over a wide range of flood events, improve the timing of flood flows, enhance existing riparian corridor ecosystems, improve water quality through groundwater recharge and the natural treatment of temporarily-stored flood waters within the floodplain and avoid reservoir desilting costs. Both ecosystem restoration and public recreational opportunities will be enhanced wherever possible within the floodplain of Antelope Creek, which currently includes a multi-purpose public trail system. In-stream improvements will include bank re-contouring to ensure overbank flows, specific habitat enhancements for fisheries, removal of invasive plant species and replanting with natives. An interpretive trail sign system and a public trailhead/community node are also proposed to improve access to the multi-purpose trail system while helping to educate the public on the project.

The Antelope Creek Improvement Project also includes improvements to the upstream Clover Valley Reservoir (to occur during Phase 3), which regulates water deliveries in the lower Antelope Canal and Creek and is operated

by PCWA. The unlined portion of the Antelope Canal, near the Union Pacific Railroad track crossing, feeds the reservoir and has experienced severe erosion and down-cutting causing the reservoir to become silted and impairing the reservoir capacity. This phase of the project will construct a pipeline to convey the water from the Antelope Canal to the reservoir to reduce or eliminate erosion, and will include dredging of the Reservoir to remove existing sediment and silt, restoring reservoir capacity and improving water quality both in the Reservoir and in the downstream Clover Valley Creek and Antelope Creek.

Aside from the individual benefits of each phase of the project, the overall Antelope Creek Improvement Project will provide flood reduction, water supply, and water quality benefits to the region. The desilting of the reservoir in Phase 3 of the project, along with the two weirs from the first two project phases, will allow for better flood management of Clover Valley and Antelope Creeks and for the overall Dry Creek Watershed. Additionally, the third phase of the project will reduce the long-term operational costs of the first two phases by possibly reducing the sediment load in Antelope Creek by reducing the frequency of weir maintenance activities.

Summary of Costs and Benefits

As documented in Attachment 4, the budgetary estimate for the Project is $5,839,747. The total present value of the project is $4,666,609 and is based on a 50-year project life cycle, which is consistent with the life cycle assumed in the flood damage reduction benefit analysis. The majority of the budget (approximately 74%) for the Antelope Creek Improvement Project is for project construction/implementation, with a portion of the budget for planning, environmental review, permitting and design (13%) in addition to smaller amounts for direct project administration, a project contingency, environmental compliance, and construction administration. Project costs will be spread out over an implementation period between September of 2011 and June of 2014. An additional $4,000 per year will be required post-construction for operations and maintenance for vegetation bank management, channel maintenance and other site-specific maintenance.

A summary of the benefits and costs for the project is provided in Table 1. Total present value costs for this project are $4,666,609 and are illustrated in Table 2.

Table 1: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$4,666,609
Monetized Benefits	
Water Supply Benefits	
Avoided Desilting Costs	$573,188
Flood Control Benefits	
Expected Flood Benefits	$268,000
Water Quality and Other Benefits	
Recreational Benefits	$147,190
Total Monetized Benefits	$988,378
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Improved Operational Flexibility for Placer County Water Agency	+
Avoided Water Costs	+
Water Quality Benefits	
Reduction in sediment loading to downstream reaches	++
Other Benefits	
Aesthetic and Educational Benefits	++
Ecosystem Improvements	+

O&M = Operations and Maintenance

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Table 2: Annual Cost of Project
(Referenced as Table 14 in Exhibit D of Proposition 1E Grant PSP)

Annual Cost of Project Project: Antelope Creek Improvement Project									
	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total cost From Table 7 (row (i), column (d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009							$0.00	1.000	$0
2010							$0.00	0.943	$0
2011	$ 443,268.00						$443,268.00	0.890	$394,509
2012	$859,636.00						$859,636.00	0.840	$722,094
2013	$2,463,835.00						$2,463,835.00	0.792	$1,951,357
2014	$2,073,008.00			$2,000	$2,000		$2,077,008.00	0.747	$1,551,525
2015				$2,000	$2,000		$4,000.00	0.705	$2,820
2016				$2,000	$2,000		$4,000.00	0.665	$2,660
2017				$2,000	$2,000		$4,000.00	0.627	$2,508
2018				$2,000	$2,000		$4,000.00	0.592	$2,368
2019				$2,000	$2,000		$4,000.00	0.558	$2,232
2020				$2,000	$2,000		$4,000.00	0.527	$2,108
2021				$2,000	$2,000		$4,000.00	0.497	$1,988
2022				$2,000	$2,000		$4,000.00	0.469	$1,876
2023				$2,000	$2,000		$4,000.00	0.442	$1,768
2024				$2,000	$2,000		$4,000.00	0.417	$1,668
2025				$2,000	$2,000		$4,000.00	0.394	$1,576
2026				$2,000	$2,000		$4,000.00	0.371	$1,484
2027				$2,000	$2,000		$4,000.00	0.350	$1,400
2028				$2,000	$2,000		$4,000.00	0.331	$1,324
2029				$2,000	$2,000		$4,000.00	0.312	$1,248
2030				$2,000	$2,000		$4,000.00	0.294	$1,176

Annual Cost of Project Project: Antelope Creek Improvement Project									
	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total cost From Table 7 (row (i), column (d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2031				$2,000	$2,000		$4,000.00	0.278	$1,112
2032				$2,000	$2,000		$4,000.00	0.262	$1,048
2033				$2,000	$2,000		$4,000.00	0.247	$988
2034				$2,000	$2,000		$4,000.00	0.233	$932
2035				$2,000	$2,000		$4,000.00	0.220	$880
2036				$2,000	$2,000		$4,000.00	0.207	$828
2037				$2,000	$2,000		$4,000.00	0.196	$784
2038				$2,000	$2,000		$4,000.00	0.185	$740
2039				$2,000	$2,000		$4,000.00	0.174	$696
2040				$2,000	$2,000		$4,000.00	0.164	$656
2041				$2,000	$2,000		$4,000.00	0.155	$620
2042				$2,000	$2,000		$4,000.00	0.146	$584
2043				$2,000	$2,000		$4,000.00	0.138	$552
2044				$2,000	$2,000		$4,000.00	0.130	$520
2045				$2,000	$2,000		$4,000.00	0.123	$492
2046				$2,000	$2,000		$4,000.00	0.116	$464
2047				$2,000	$2,000		$4,000.00	0.109	$436
2048				$2,000	$2,000		$4,000.00	0.103	$412
2049				$2,000	$2,000		$4,000.00	0.097	$388
2050				$2,000	$2,000		$4,000.00	0.092	$368
2051				$2,000	$2,000		$4,000.00	0.087	$348
2052				$2,000	$2,000		$4,000.00	0.082	$328
2053				$2,000	$2,000		$4,000.00	0.077	$308
2054				$2,000	$2,000		$4,000.00	0.073	$292
2055				$2,000	$2,000		$4,000.00	0.069	$276

Annual Cost of Project
Project: Antelope Creek Improvement Project

	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total cost From Table 7 (row (i), column (d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2056				$2,000	$2,000		$4,000.00	0.065	$260
2057				$2,000	$2,000		$4,000.00	0.061	$244
2058				$2,000	$2,000		$4,000.00	0.058	$232
2059				$2,000	$2,000		$4,000.00	0.054	$217
2060				$2,000	$2,000		$4,000.00	0.051	$205
2061				$2,000	$2,000		$4,000.00	0.048	$193
2062				$2,000	$2,000		$4,000.00	0.046	$182
2063				$2,000	$2,000		$4,000.00	0.043	$172
2064				$2,000	$2,000		$4,000.00	0.041	$162
								Total Present Value of Discounted Costs (Sum of Column (i))	**$4,666,609**

Comments:
All three phases of the project are passive projects that do not have regular administrative or operational costs.

Maintenance and replacement costs are included because the ALERT-type stream level and precipitation gauges that will be installed as part of the flood control improvements will require periodic maintenance and replacement. The National Weather Service's Weather Service Hydrology Handbook No. 2 notes that maintenance and life-cycle replacement costs each run around 10% of capital investment per year. For these calculations, 5% of the capital investment associated with the gauges is attributed to maintenance and the other 5% to replacement.

The "Without Project" Baseline

Antelope Creek is a perennial creek draining the northeast portion of the Dry Creek watershed. The mainstem is approximately 9.5 miles long and the watershed area is 21.4 square miles. The Antelope Creek system is composed of approximately 12.4 miles of intermittent tributaries in addition to the main tributary, Clover Valley Creek.

Antelope Creek and Miners Ravine combine with Clover Valley Creek and Secret Ravine, respectively, near Interstate 80 and Atlantic Street in Roseville to form Dry Creek. Cirby Creek, made up of the combination of Cirby and Linda Creeks and Strap Ravine, joins Dry Creek just upstream of Riverside Avenue in Roseville. Downstream of Roseville, just downstream of Elverta Road, Dry Creek branches into North Dry Creek and Dry Creek and forms Cherry Island in the Rio Linda area. Without the proposed project, the City of Roseville and unincorporated areas of Placer County will continue to be repeatedly damaged during storm events as a result of bank overtopping. Additionally, the quality of water transmitted by the creeks will continue to be degraded by sediment erosion and turbidity, and PCWA's operational flexibility will continue to be compromised (limited) as a result of the sedimentation build-up in Clover Valley Reservoir.

Water Supply Benefits

This section describes the water supply benefits generated by this project, including augmentation of local groundwater supplies and improved water supply reliability and operational flexibility. The present value calculations for the avoidance of desilting the Clover Valley Reservoir due to the permanenet pipeline that bypasses the unlined portion of the Antelope Canal are provided in Table 3.

Reduced Maintenance Costs for Clover Valley Reservoir

The permanent pipeline that will bypass the unlined portion of Antelope Canal will reduce the maintenance costs for the Clover Valley Reservoir by reducing the frequencty that the Reservoir needs to be desilted. Currently, the Reservoir must be desilted every twenty years at a cost of $1,338,009 (2009 dollars). With the project implemented, it is estimated that the reduction in sediment entering the reservoir from the pipeline will reduce the need for reservoir desilting such that it will only required once every 30 years. Table 3 depicts the avoided maintenance costs with the proposed project. The total present value benefit from the reduced frequency of reservoir desilting is $573,188.

Table 3: Avoided Costs of Desilting Clover Valley Reservoir
(Referenced as Table 15 in Exhibit D of Proposition 1E Grant PSP)

Table 15 - Annual Water Supply Benefits: Avoided Desilting of Clover Valley Reservoir
(All benefits in 2009 dollars)
Project: Antelope Creek Improvement Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change Resulting from Project	Unit $ Value	Annual $ Value	Discount Factor	Discounted Benefits
		(Units)			(e) – (d)		(f) x (g)		(h) x (i)
2011	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.89	$0
2012	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.84	$0
2013	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.79	$0
2014	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.75	$0
2015	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.70	$0
2016	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.67	$0
2017	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.63	$0
2018	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.59	$0
2019	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.56	$0
2020	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.53	$0
2021	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.50	$0
2022	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.47	$0
2023	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.44	$0
2024	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.42	$0
2025	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.39	$0
2026	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.37	$0
2027	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.35	$0
2028	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.33	$0
2029	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.31	$0

Table 15 - Annual Water Supply Benefits: Avoided Desilting of Clover Valley Reservoir
(All benefits in 2009 dollars)
Project: Antelope Creek Improvement Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change Resulting from Project	Unit $ Value	Annual $ Value	Discount Factor	Discounted Benefits
		(Units)			(e) – (d)		(f) x (g)		(h) x (i)
2031	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.28	$0
2032	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.26	$0
2033	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.25	$0
2034	Avoided Desilting	LS	1	0	1	$1,338,009	$1,338,009	0.23	$311,754
2035	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.22	$0
2036	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.21	$0
2037	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.20	$0
2038	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.18	$0
2039	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.17	$0
2040	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.16	$0
2041	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.15	$0
2042	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.15	$0
2043	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.14	$0
2044	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.13	$0
2045	Avoided Desilting	LS	0	1	1	$1,338,009	$1,338,009	0.12	$164,228
2046	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.12	$0
2047	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.11	$0
2048	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.10	$0
2049	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.10	$0
2050	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.09	$0
2051	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.09	$0
2052	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.08	$0

Table 15 - Annual Water Supply Benefits: Avoided Desilting of Clover Valley Reservoir
(All benefits in 2009 dollars)
Project: Antelope Creek Improvement Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change Resulting from Project	Unit $ Value	Annual $ Value	Discount Factor	Discounted Benefits
		(Units)			(e) – (d)		(f) x (g)		(h) x (i)
2053	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.08	$0
2054	Avoided Desilting	LS	1	0	1	$1,338,009	$1,338,009	0.07	$97,206
2056	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.06	$0
2057	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.06	$0
2058	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.06	$0
2059	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.05	$0
2060	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.05	$0
2061	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.05	$0
2062	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.05	$0
2063	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.04	$0
2064	Avoided Desilting	LS	0	0	0	$1,338,009	$0	0.04	$0
Project Life								…	
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		$573,188

Comments: Unit $ Value is calculated from the desilting costs that are provided in Attachment 4. The avoided costs include construction, engineering, permitting and environmental mitigation. Contingency was not included.

Improved Operational Flexibility for Placer County Water Agency (PCWA)

The proposed Phase 3 improvements of the Antelope Creek Improvement Project include desilting of the Clover Valley Reservoir and constructing a pipeline to bypass the unlined portion of the Antelope Canal, near the Union Pacific Railroad track crossing, that has experienced severe erosion and down-cutting causing the reservoir to become silted, impairing the reservoir capacity, and increasing sediment-loading to Clover Valley Creek and further downstream in Antelope Creek. Desilting of the reservoir will increase the flow-regulating capacity of the reservoir (minimizing releases downstream during flood events) and will provide PCWA with increased operational flexibility, especially during the fall months when PG&E's Bear River Canal is shut down for maintenance. PCWA receives a significant amount of their water supplies from the Bear River Canal, and during PG&E's annual canal maintenance, PCWA must store enough water in their system to meet shortfall. The added capacity provided by the reservoir desilting helps PCWA offset the shortfalls experienced annually and provides the retail purveyor with more water system stability. By diverting the section of canal that is insizing the hillside into a pipelne, the water quality within Clover Valley Creek and Antelope Creek as well as Clover Valley Reservoir will be improved.

By avoiding the use of imported water, the project will marginally help PCWA in their supply efforts by allowing for longer shutdowns, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables for the same reasons as discussed for improved water supply reliability.

Local Groundwater Supply Augmentation

As a result of the Antelope Creek Improvement Project, stormwater will be retained behind the new on-stream weirs and percolated to groundwater. This water would be stored in the underlying groundwater aquifers of the North American Groundwater Sub-basin and made available for use in future years. The City of Roseville, Sacramento Suburban Water District, and San Juan Water District, all members of the Regional Water Authority, use local groundwater to meet demands. It is assumed that this groundwater would be used by these agencies via existing infrastructure to reduce reliance on surface water supplies, resulting in a decrease in water supply costs for the agency.

Increased Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. As previously noted, the availability of PCWA surface water supply varies based on weather conditions and infrastructure maintenance downtime. By restoring the operating capacity of Clover Valley Reservoir, the Antelope Creek Improvement Project will improve water supply reliability within the PCWA service area. The proposed project will increase the supply reliability for PCWA customers by increasing the operational capacity of the Clover Valley Reservoir and increasing the amount of groundwater available in the future. Additionally, groundwater is not subject to rapid fluctuations like surface water and can be a more dependable supply if sustainably managed; therefore, this project will also provide benefits to the City of Roseville, Sacramento Suburban Water District, and San Juan Water District, all members of the Regional Water Authority and users of groundwater.

Although interest in water supply reliability is increasing (due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market

valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought). In most cases, this is the amount customers would be willing to pay in addition to their current water bill.

The challenge for use of these values in determining a value of increased reliability as a result of the project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas the Antelope Creek Improvement Project only enhances overall reliability, but does not guarantee 100% reliability. Thus, if applied directly to the number of households within the PCWA service area, the dollar values from the studies would overstate the reliability value provided by the proposed project. Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables.

Improved Water Quality

Water quality benefits will also be achieved as a result of the Antelope Creek Improvement Project through the reduction in sediment loading to Clover Valley Reservoir and downstream reaches of Clover Valley Creek and Antelope Creek. By limiting the amount of sediment entering the Reservoir via the Reservoir's connection to the adjacent canal system (vis-à-vis the pipeline installation), the diverted water will no longer be in contact with bare earth, resulting in reduced sediment load, turbidity and exposure to other soil contaminants and organics. These benefits will also be transferred to Antelope Creek and other creeks when waters from Clover Valley Reservoir flow into the downstream reaches during high flows.

Distribution of Project Benefits

In terms of water supply, the Antelope Creek Improvement Project will benefit stakeholders at the local and regional level. PCWA and its customers and the western portion of Placer County will benefit due to reduced water supply costs, increased reliability of supply, and reduced groundwater overdraft.

Table 4: Project Beneficiaries Summary

Local	Regional
PCWA	Placer County Water Agency, City of Roseville

Project Benefits Timeline Description

The project's water supply benefits will be immediately achieved through project construction, scheduled to occur between May 2013 and June 2014. Construction of the Antelope Canal to Clover Valley Reservoir pipeline conveyance, combined with the proposed reservoir desilting, will immediately reduce the sediment loading to downstream Clover Valley Creek and Antelope Creek and will immediately restore the operational capacity of Clover Valley Reservoir.

Potential Adverse Effects from the Project

As with any stormwater infiltration project, there is the potential for the infiltration of stormwater to carry pollutants into the subsurface. However, given the incremental nature of the water supply benefits provided by this project (e.g. the limited amount of stormwater infiltration) and considering the occurrence of soil aquifer treatment resulting during the infiltration and percolation processes, there are no potential adverse effects associated with the project.

Summary of Findings, Tables

The monetized water supply benefit from the proposed project is the avoided cost of desilting Clover Valley Reservoir. Non-monetized benefits of the project include avoided cost of potable water, increased water supply reliability in the area and improved operational flexibility for Placer County Water Agency. These benefits are listed again in Table 5.

The Antelope Creek Improvement Project will cost roughly $4,666,609 in present value discounted costs, and it will save $573,188 in present value due to the avoided costs of desilting Clover Valley Reservoir.

Table 5: Qualitative Benefits Summary – Water Supply Benefits

Benefit	Qualitative Indicator
Avoided Water Costs	+
Increased Water Supply Reliability	+
Improved Operational Flexibility for Placer County Water Agency (PCWA)	++

In addition, this project will convey water quality benefits as the raw water transported from the Bear River Canal into Clover Valley Reservoir will be in contact with bare earth for a shorter period of time, resulting in reduced sediment load, turbidity and exposure to other soil contaminants and organics. These benefits will also be transferred to Antelope Creek and other creeks where waters from Clover Valley Reservoir spill into downstream creek reaches during high flows.

Table 6: Qualitative Benefits Summary – Water Quality Benefits

Benefit	Qualitative Indicator
Reduced sediment loading and turbidity into Clover Valley Reservoir and downstream creek reaches	++

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the extent to which this project will promote groundwater recharge. These issues are listed in Table 7.

Table 7: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided Desilting Costs	+	For the avoided costs of desilting, contingency was not included; therefore, the actual costs of desilting maintenance may be higher than estimated resulting in a higher benefit.
Benefit of supplemental groundwater supply	U	The volume of potential stormwater infiltration to the underlying aquifers of the North American Groundwater Sub-basin is not quantifiable and will vary with time and runoff frequency and volume.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.